

Claims

1. A method for the liquefaction of a hydrocarbon-rich
5 flow, whereby the liquefaction of the hydrocarbon-rich
flow is effected against a refrigerant circuit cascade
consisting of three refrigeration circuits, whereby
the first of the three refrigeration circuits serves
to provide preliminary cooling, the second
10 refrigeration circuit serves to provide the actual
liquefaction, and the third refrigeration circuit
serves the sub-cooling of the liquefied hydrocarbon-
rich flow, and whereby each refrigeration circuit
comprises at least one single-stage or multi-stage
15 compressor, characterised in that at least one part
flow of the refrigerant of the second refrigeration
circuit is used for the preliminary cooling of the
hydrocarbon-rich flow.
- 20 2. A method as claimed in claim 1 wherein the part flow
of the refrigerant of the second refrigeration
circuit used for the pre-cooling of the hydrocarbon-
rich flow is evaporated at a pressure which is higher
than the evaporation pressure of the remaining part
25 flow of the refrigerant of the second cooling circuit,
and is conducted to the compressor of the second
cooling circuit at an intermediate pressure level.
3. A method as claimed in claim 1 or 2 wherein the
30 separation of unwanted components and/or components of
the hydrocarbon-rich flow which freeze out during the
liquefaction of the hydrocarbon-rich flow takes place
before the actual liquefaction of the hydrocarbon-rich
flow.
- 35 4. A method as claimed in claim 3, wherein at least one
part flow of one of the two part flows of the second

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cooling circuit is used for the provision of cooling in the separation unit.

- 5 5. A method as claimed in any preceding claim wherein the volumes and/or evaporation pressures of the two part flows of the second refrigeration circuit are changeable.
- 10 6. A method as claimed in any preceding claim wherein the hydrocarbon rich stream is a natural gas flow.
- 15 7. A method as claimed in any preceding claim wherein each compressor has a substantially equal share of the load.
- 20 8. A method as claimed in any preceding claim wherein the first refrigeration circuit comprises carbon dioxide.
- 25 9. A method as claimed in any of claims 1 to 7 wherein all the refrigeration circuits comprise mixed refrigerants.
- 30 10. A method of liquefying a hydrocarbon-rich gas, wherein the gas flows through a cascade of three refrigeration stages, each stage comprising a refrigerant circuit and a compressor, wherein at least part of the flow of refrigerant from the second circuit is used for the preliminary cooling of the hydrocarbon rich gas in the first refrigeration stage.
- 35 11. A method of liquefaction comprising a plurality of cooling circuits arranged in a cascade formation, each circuit comprising a compressor, wherein each compressor has a substantially equal share of the total load.

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12. A method as claimed in claim 11 wherein the cascade comprises at least first and second cooling circuits, the second cooling circuit being used at least partially for pre-cooling the substance to be liquefied.

13. A method as claimed in claim 11 or 12 wherein the method is a method of liquefaction of a hydrocarbon rich flow.

14. A method as claimed in claim 13 wherein the first cooling circuit comprises carbon dioxide.

15. A substantially load balanced mixed refrigerant cascade process comprising a carbon dioxide pre-cooling circuit.

16. A substantially load balanced mixed refrigerant cascade process as claimed in claim 15 wherein the carbon dioxide is cooled after condensation to a temperature of 20°C or less.

17. A substantially load balanced process as claimed in claim 16 wherein the carbon dioxide is cooled to a temperature of 15°C or less.

18. A substantially load balanced process as claimed in claim 16 or 17 wherein cold cooling water is used to cool the carbon dioxide.

19. A substantially load balanced process as claimed in claim 18 wherein the cold cooling water is sea water.

20. A substantially load balanced process as claimed in any of claims 15-19, wherein the carbon dioxide pre-cooling circuit includes a sub-cooling heat exchanger installed after the condenser.

21. A substantially load balanced process as claimed in any of claims 15-20, wherein the carbon dioxide cooling circuit comprises three pressure levels.

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22. A substantially load balanced process as claimed in any of claims 15-21, wherein the carbon dioxide is not subcooled in the pre-cooling circuit.

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23. A substantially load balanced process as claimed in any of claims 15-22, wherein a high pressure casing is used with the carbon dioxide compressor.

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24. A substantially load balanced process as claimed in claim 23 wherein the compressor is split into two casings and a barrel type casing used for the high pressure stage.

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25. An LNG liquefaction process comprising three cascade cycles each driven by a compressor, wherein the compressors are substantially equally loaded and one of the cascade cycles is a carbon dioxide cycle.

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26. A method for the liquefaction of a hydrocarbon-rich flow, whereby the liquefaction of the hydrocarbon-rich flow is effected against a refrigerant circuit cascade consisting of three mixed refrigeration circuits, whereby the first of the three refrigeration circuits serves to provide preliminary cooling, the second refrigeration circuit serves to provide the actual liquefaction, and the third refrigeration circuit serves the sub-cooling of the liquefied hydrocarbon-rich flow, and whereby each refrigeration circuit comprises at least one single-stage or multi-stage compressor, characterised in that at least one part flow of the refrigerant of the second refrigeration

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circuit is used for the preliminary cooling of the hydrocarbon-rich flow.